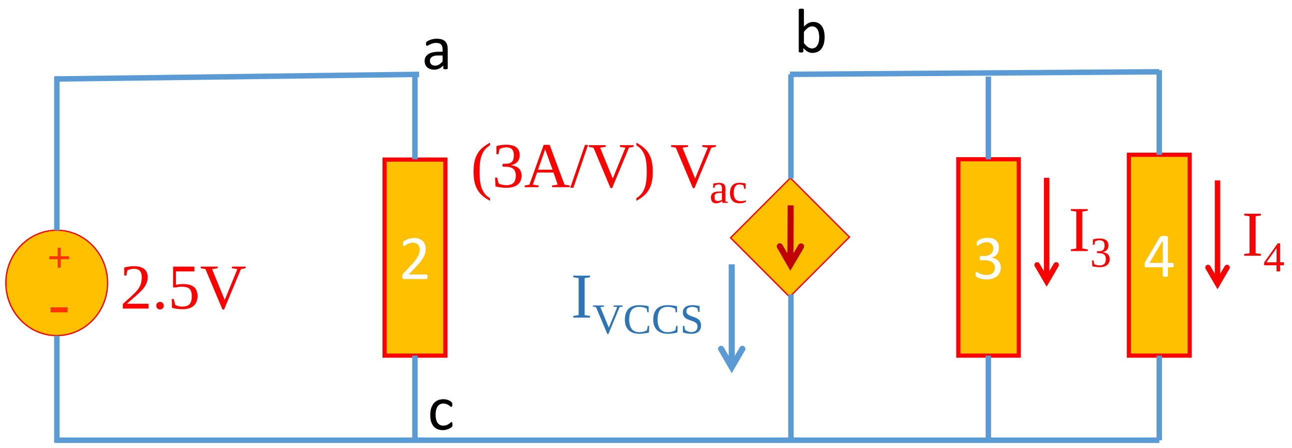
EECS/CSE 70A Network Analysis I

Homework #2 Solution

Problem 1: (VCCS) Find $I_3 + I_4$.



Solution:

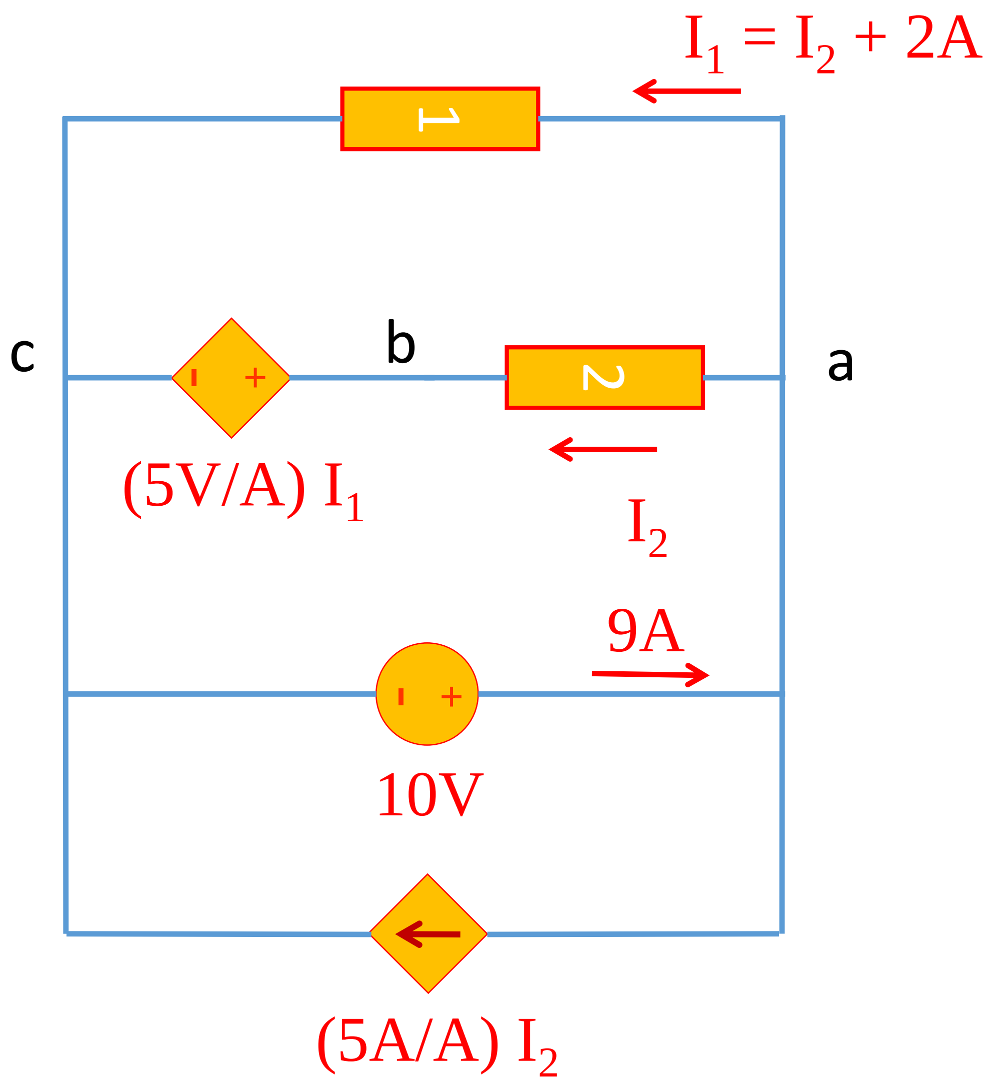
$V_{ac} = 2.5V$

VCCS current = I_{VCCS} = (3A/V) V_{ac} = 7.5A

KCL @ node b: $I_3 + I_4 + I_{VCCS} = 0$

→ $I_3 + I_4 = -7.5A$

Problem 2: (CCVS/CCCS) Find I_1, I_2 and V_{bc}



Solution:

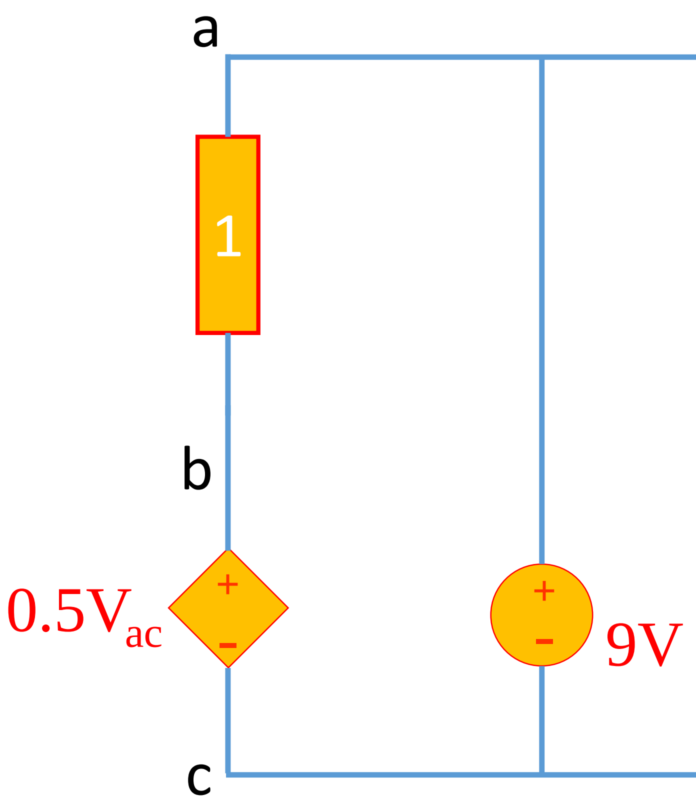
$V_{ac} = 2.5$ V

KCL @ node a: $I_1 + I_2 - 9A + 5I_2 = 0$

From the question we know $I_1 = I_2 + 2A$

→ $I_2 = 1$ A, $I_1 = 3$ A, $V_{bc} = 5I_1 = 5$ V

Problem 3: (VCVS) Find V_{bc} and V_{ab} .

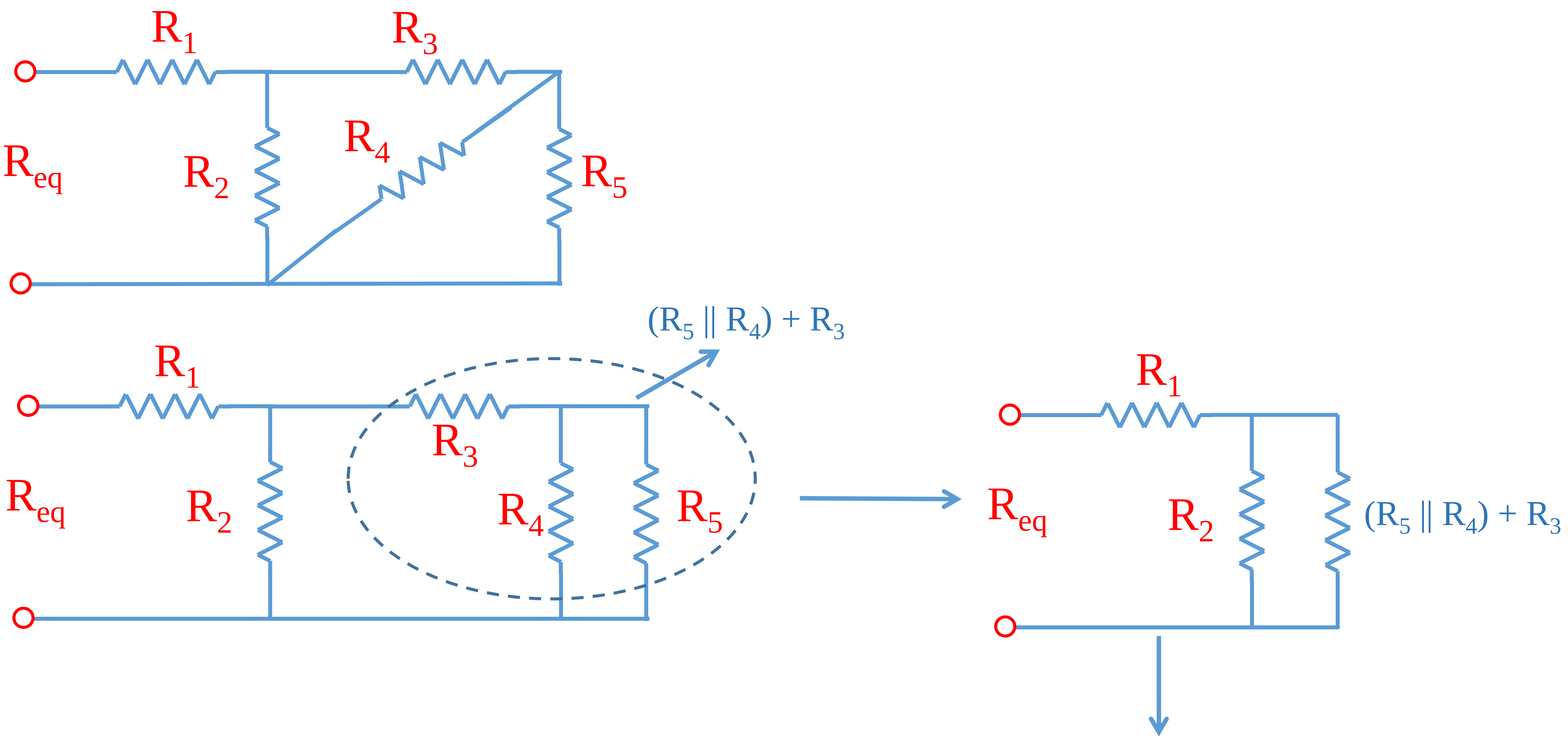


Solution:

$V_{ac} = 9V \rightarrow V_{bc} = 0.5 \times V_{ac} = 4.5V$

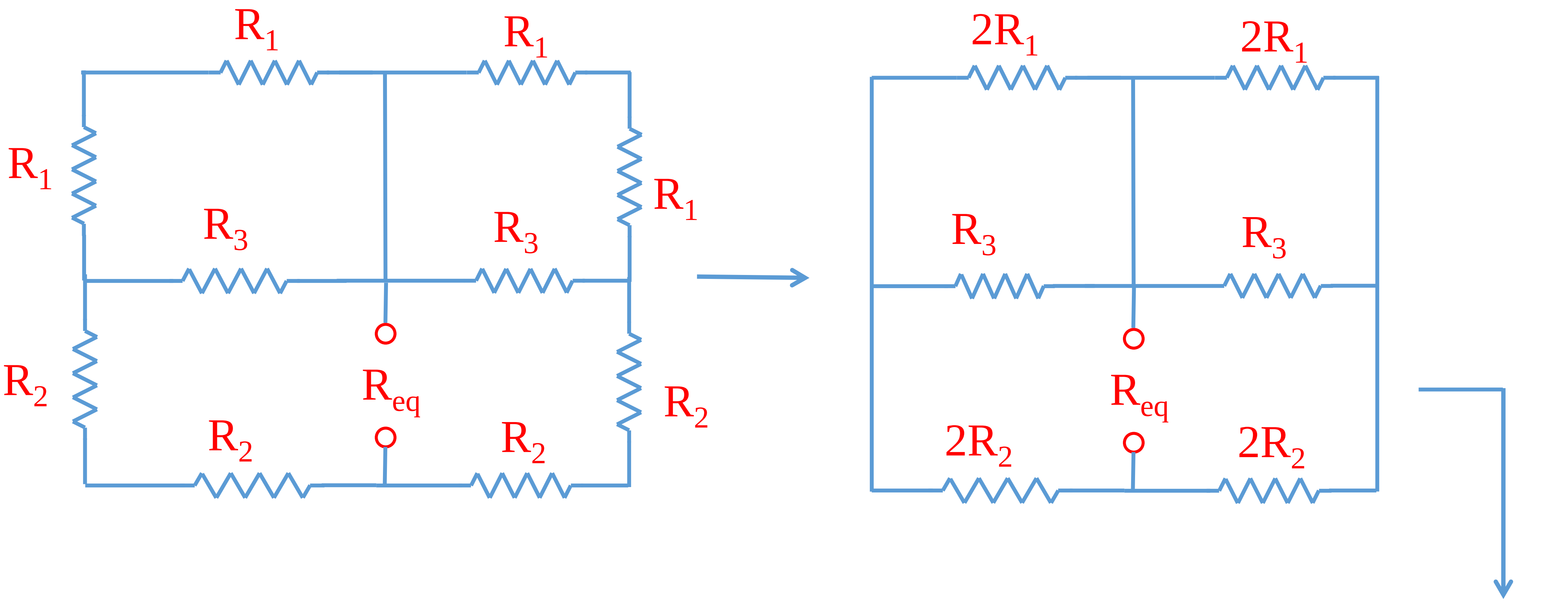
$V_{ab} = V_{ac} - V_{bc} = 4.5V$

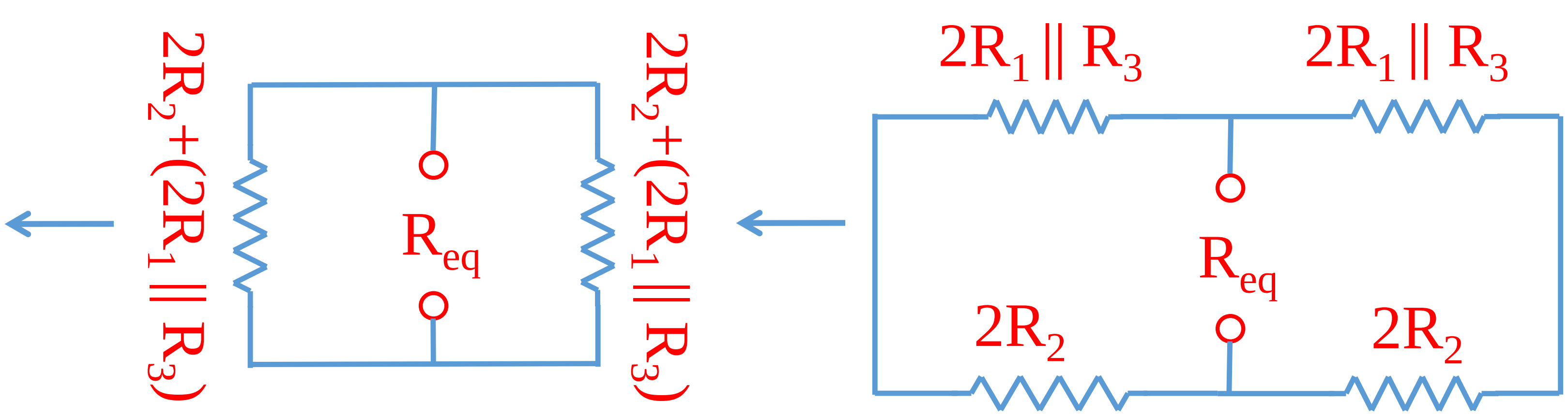
Problem 4: Find R_{eq} . Please use the parallel sign "//" as discussed in class.



$$R_{eq} = [(R_5 \parallel R_4) + R_3] \parallel R_2 + R_1$$

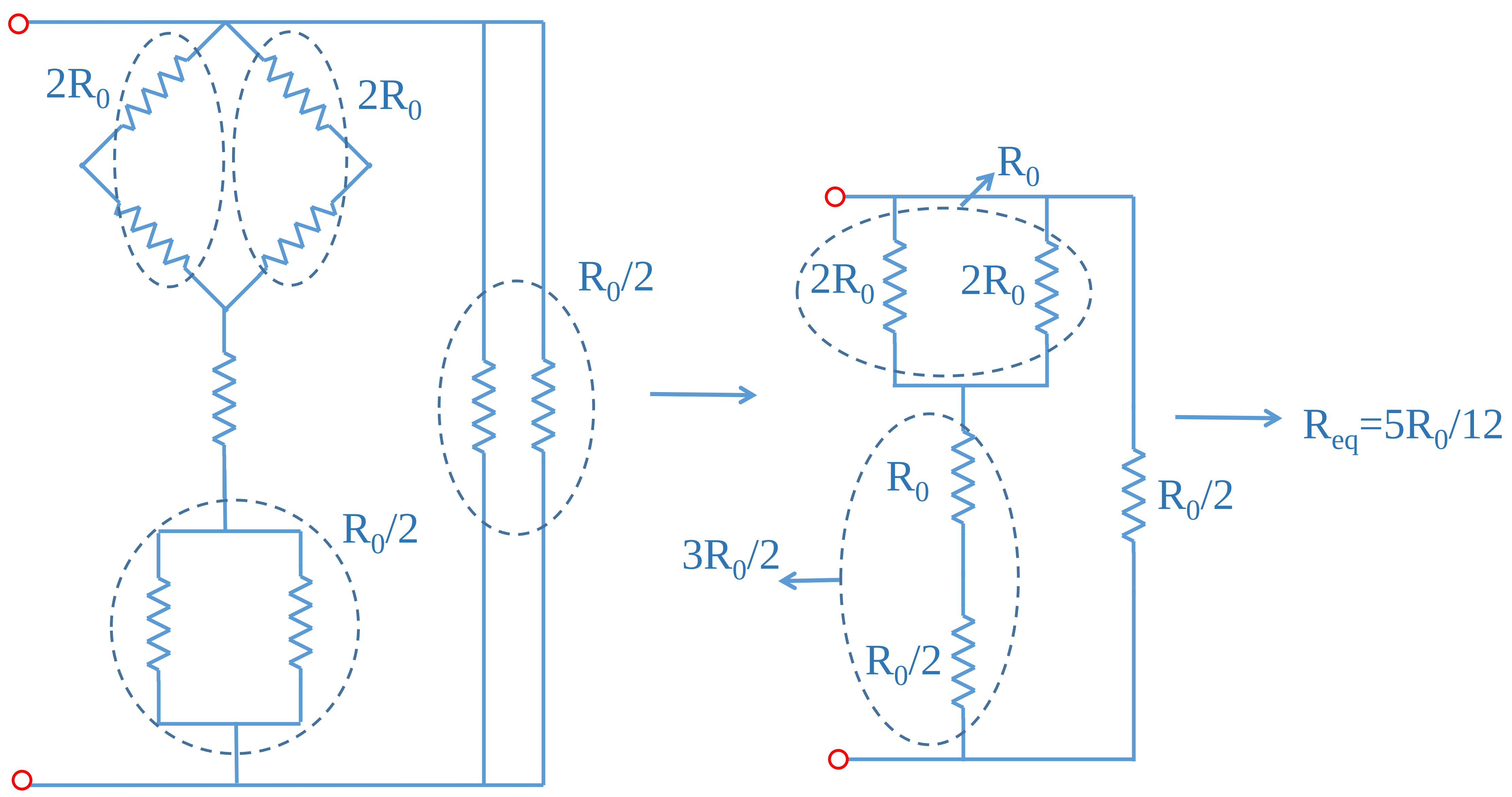
Problem 5: Find R_{eq} .



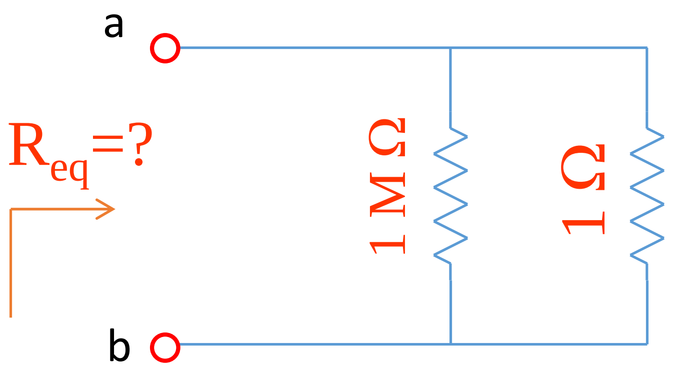


$R_{eq} = R_2 + (2R_1 \,||\, R_3)/2$

Problem 6: All of the resistors below are R_0 Ω. Find R_{eq} .



Problem 7: Find R_{eq} using Taylor series approximation of the appropriate function to the second order accuracy.



$$f(x) = \frac{1}{1+x}$$

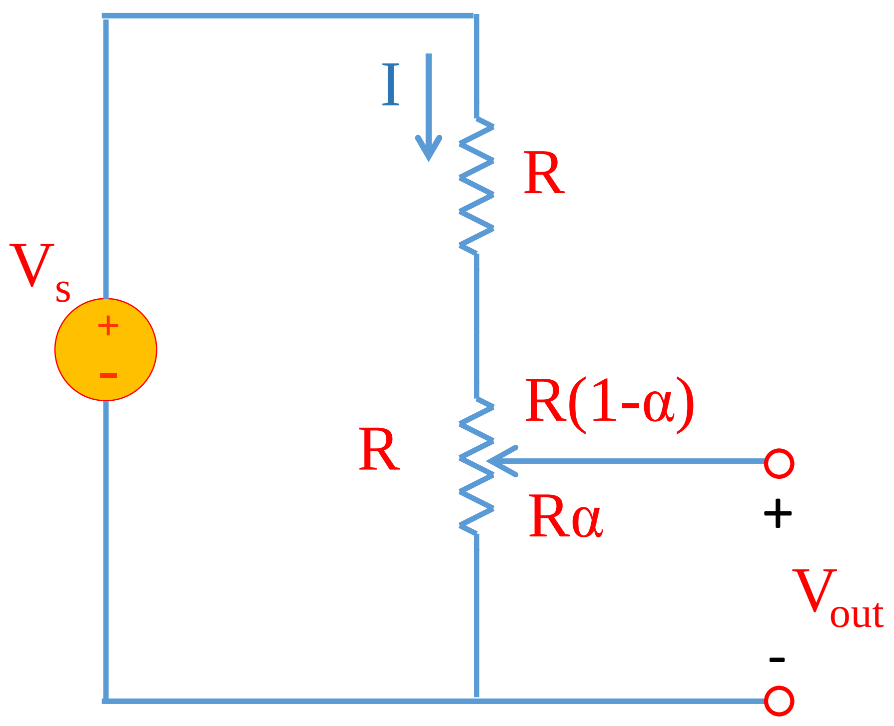
$$f(x) = f(a) + \frac{f'(a)}{1!}(x-a) + \frac{f''(a)}{2!}(x-a)^2$$

($R_{eq} = \frac{1M*1}{1M+1} = \frac{1}{1+10^{-6}}$)

For the Taylor series (which is expanded up to the second order) we have a = 0 and we want to evaluate the function at $x = 10^{-6}$

$$R_{eq} = f(x) = 1 + \frac{-1}{1!}(10^{-6}) + \frac{2}{2!}(10^{-6})^2 = 0.999999000001$$

Problem 8: (Potentiometer) In the circuit below, the wiper divides the potentiometer resistance R between two resistances R(1-α) and Rα where 0<α<1. α is a parameter modeling the wiper's position. Find the value of α such that the output voltage V_{out} becomes one-third of V_s



Solution:

$I = V_s / (R + R(1-\alpha) + R\alpha) = V_s / (2R)$

$V_{out} = R\alpha \times I = R\alpha \times V_s / (2R)$

We need $V_{out} = V_s/3 \rightarrow \alpha = 2/3$